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UPPER BODY LOADING IN RUGBY UNION TACKLING ARE AFFECTED BY TACKLE DIRECTION AND IMPACT SHOULDER

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INTRODUCTION

Approximately 25% of Rugby Union injuries occur to players executing a tackle and they mostly involve upper-body regions. Tackles are typically unpredictable, and very difficult to analyse from a biomechanical perspective. We designed a novel tackle simulator to investigate tackling biomechanics in a more ecologically valid laboratory setup, and we measured upper-body loading under different tackling conditions.

METHODS

In a repeated-measures study design 6 male Rugby Union players, all right-side dominant (26.7 ± 7.6 years; 1.82 ± 0.09 ; 95.7 ± 14.0 kg) performed full tackling trials against a bespoke tackle simulator (Fig. 1) starting from a 3-step run up. Participant executed tackles with dominant and non-dominant shoulder and from 3 different directions (frontal $[0^\circ]$, 45° and 90° to the travel direction of the tackle bag).

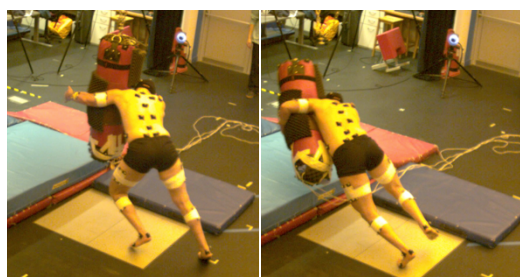


Figure 1: Example of experimental set-up during the 90° non-dominant shoulder tackle using the tackle simulator.

Four pressure sensor (VersaTek XL, Tekscan Inc, USA) were placed onto the punch bag and allowed the estimation of tackle impact forces (500 Hz). Participant and punch bag motion were captured at 250 Hz through a 16-camera motion capture system (Oqus, Qualisys, Sweden) with eight reflective markers on the punch bag and a 74-landmarks total-body marker-set (Seminati et al., 2016). An inertial measurement unit (IMU) (MTw, Xsens Technology B.V., NL) measured 3D accelerations and angular velocities (100 Hz) on the participant's forehead. Linear mixed models and magnitude-based inferences were used to assess the effect of different tackling conditions on the selected biomechanical variables (Hopkins, 2010). Bag velocity at impact was included as a covariate.

RESULTS

Dominant shoulder tackles in the frontal direction generated the highest impact forces,

5.3 ± 1.0 kN (15% higher than non-dominant shoulder tackles). Impact load decreased going from frontal to diagonal (-3%) and lateral tackling (-10%). The lowest peak head accelerations (substantially lower [-5%] compared to frontal tackles) were recorded during diagonal tackles, with the dominant shoulder (9.1 ± 3.5 g). Resultant head angular velocity was substantially lower when tackling from 45° and 90° than from a frontal position and the lowest head angular velocities (13.5 ± 5.2 rad/s) were recorded when tackling with the non-dominant shoulder at 90° . Mean neck flexion angles at impact were substantially greater (by 20%) for non-dominant than for dominant shoulder in each of the three tackling directions evaluated. Also, the lowest neck flexion angles ($-13 \pm 7^\circ$) were recorded when players tackled from 45° , with the left shoulder.

DISCUSSION

The results are in line with the outcomes obtained in previous studies on tackling without a run-up phase (Seminati et al., 2016): both laterality and tackle direction have a substantial effect on the loads applied to the upper-body of the tackler. Overall, a more 'passive' behaviour (i.e. lower peaks and longer breaking phase) during non-dominant shoulder tackles. From a kinematic perspective, players employed a more 'head-up' technique during dominant shoulder tackles, which is in line with BokSmart and RugbySafe guidelines. This evidence supports the technique suggested by the guidelines for safe and effective rugby techniques (i.e. BokSmart and Rugby Safe), which recommend tackling at an angle between 15 - 45° to the running direction of the ball carrier. This approach can reduce the tackle impact force, while maintaining tackle effectiveness.

CONCLUSION

Where feasible, the tackler should control tackling technique as it may have important implications for injury prevention. Coaching should aim to reduce the deficiencies in tackling technique on the non-dominant side, including encouraging better head-neck control.

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ABSTRACT SUBMISSION INFORMATION

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